NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FLOODWATER DIVERSION

(feet)

CODE 400

DEFINITION

A graded channel with a supporting embankment or dike on the lower side constructed on lowland subject to flood damage.

PURPOSES

This practice may be installed as part of a resource management system to support one or more of the following:

- Improve the crop-growing environment of lowlands by diverting floodwaters.
- Improve water quality by limiting overland flow across agricultural land.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to the construction of a graded channel and embankment to divert floodwater from downslope areas. It does not apply to Diversions (Code 362) or Floodways (Code 404).

This practice is applicable if:

1. Floodwater originating outside the lowland area to be protected is causing damage to agricultural land, crops, or improvements or is expected to cause damage to improvements to be made in the area.
2. An adequate outlet for the design flow is available, either by gravity flow or by pumping. The outlet shall be suitable for the quality and quantity of water and sediment to be disposed of, with consideration of possible damages above or below the point of discharge that might involve legal actions under state law. The outlet can be a Floodway (Code 404) or a natural channel, river, lake, bay, or tidal estuary.
3. Land to be protected is suitable for agriculture within its capabilities after installation of required conservation practices.

CRITERIA

General criteria applicable to all purposes

Location

The floodwater diversion shall be located to protect the maximum area of lowland, consistent with economic limitations, topographic requirements, and the desired slope of the hydraulic grade line.

In selecting the location for floodwater diversions, consideration shall be given to the preservation of existing fish and wildlife habitat, trees of significant value for wildlife food, dens or shelter, and existing visual resources.

Capacity

Floodwater diversions shall have the capacity to carry the peak runoff to be expected from a 10-year frequency, 24-hour duration storm. If farmsteads, public roads, or other improvements are within the area to be protected, the design capacity shall be consistent with the hazard involved but shall not be less than the peak flow from a 25-year, 24-hour storm.

Hydraulic grade line

The hydraulic grade line of the floodwater diversion shall match the elevation of water in the outlet for the frequency storm selected for design. Hydraulic grade lines shall be established with due consideration of damages that may occur on the upslope side of the floodwater diversion and adjacent property. The floodwater diversion shall have a grade in the direction of flow that will result

in a velocity that is adequate to carry the required runoff without erosion or sedimentation.

Velocity

If site conditions indicate that erosion is likely to be a hazard because of a higher velocity resulting from a lower roughness coefficient immediately after construction and before establishment of vegetation, such lower value of roughness coefficient shall be estimated. The resultant velocities shall be considered in designing the channel and planning protective measures. The criteria for Open Channels (582) regarding channel stability, velocity, and roughness coefficient shall be followed.

The maximum permissible design velocity shall be based on site conditions and determined by procedures described in TR-25, Planning and Design of Open Channels. A desirable minimum velocity is 1.5 ft/s. On flat grades where the design velocity is below this value, the cross section shall be adjusted to obtain the most efficient section that depth and maintenance methods permit.

Berm and embankment

The minimum berm width between an excavated channel and embankment shall be based on the depth of the channel.

Depth of channel	Minimum berm
ft	*ft*
2 - 4	4
4 - 6	6
6 - 8	10
More than 8	15

Wider berms than indicated should be used if site conditions permit.

The earthfill embankment can be constructed of material obtained from the channel excavation, if suitable, or from designated borrow areas.

The design height of the embankment shall be the design water surface (hydraulic grade line) plus a freeboard of at least 2 feet. The constructed height shall be the design height plus an allowance for settlement based on consideration of soil material and anticipated compaction during construction, but such allowance shall be no less than 5 percent of the design height.

Cross section

The design cross section shall be set below the design hydraulic grade line and shall include the entire cross-sectional area bounded by: the embankment, the berm between embankment and channel, the channel, and the flow area on the upslope side of the channel opposite from the embankment.

Minimum cross section requirement for compacted fill

Minimum requirements for the cross section of the embankment where fill is compacted by hauling or special equipment shall be:

Design water height	Minimum top width	Steepest side slope
ft	*ft*	*ft*
0-6	6	1.5:1
6-12	8	2:1

Minimum cross section for dumped fill

If because of soils or water conditions it is impractical to compact the embankment with hauling or special equipment, dumped fills may be used. Dumped fill shall have minimum cross section dimensions incorporated within the fill as follows:

Design water height	Minimum top width	Steepest side slope
ft	*ft*	*ft*
0-6	10	2:1
6-12	14	2.5:1

Side slopes of 3:1 on waterside and 2:1 on landside may be used instead of 2.5:1 for both slopes.

Vegetative cover

An adequate cover of grasses shall be established on all disturbed areas for protection against erosion by flood flows, wave action, or rainfall and runoff. Seedbed preparation, seeding, sprigging or sodding, fertilizer, mulching, and fencing shall conform to requirements of Construction Specification 342, Critical Area Planting.

Maintenance access

Maintenance access shall be provided as specified in the standard for Open Channels (582).

CONSIDERATIONS

Water Quantity

1. Effect on the water budget, especially on volumes and rates of runoff, evaporation, infiltration, deep percolation, and ground water recharge.
2. Effects of changes in plant growth and transpiration because of changes in the amount of soil water in the vicinity of the structure.
3. Effects of eliminating filling of depressions and potholes on the flood plain.

Water Quality

1. Effects of the movement of sediment and soluble and sediment-attached substances or other toxics carried by runoff.
2. Effects of erosion, including the downstream stability of streambanks and streambeds.
3. Effects of changes in ground water contamination by soluble substances because of decreases in infiltrating floodwater.
4. Effects on the visual quality of downstream water resources.

PLANS AND SPECIFICATIONS

Plans and specifications for construction floodwater diversions shall be in keeping with this standard and shall describe the requirements for construction to achieve the intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan must be prepared for use by the landowner or operator responsible for floodwater diversion operation and maintenance. The plan should provide specific instructions for operating and maintaining the diversion to insure it functions properly. Minimum requirements to be addressed in the Operation and Maintenance Plan are:

1. Prompt repair or replacement of damaged components is necessary.
2. Maintain hydraulic capacities of the floodwater channel, and control structures.
3. Remove debris and litter from floodwater diversion surfaces, and inlet and outlet facilities.
4. Periodically check the elevation of the earthfills and restore to grade, if necessary. All settlement or cracks in the earthfill should be investigated to determine the cause and immediately repaired.
5. Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control height.
6. Maintain installed fences to prevent unauthorized human access or uncontrolled grazing of floodwater surfaces.
7. Eradicate or otherwise remove all rodents or burrowing animals and repair any damage caused by their activity.
8. Immediately repair any vandalism, vehicular, or livestock damage.

REFERENCES

USDA NRCS, National Engineering Field Handbook, Chapters 2, 3, 13, and 16.

USDA NRCS, National Engineering Handbook Series.

USDA NRCS, Technical Release 25 - Planning and Design of Open Channels.

USDA NRCS, Standard Drawings Handbook - Washington.

USDA NRCS, Engineering Design Standards - Far West States.